



**Equipment Engineering and Quality Assurance
Technical Specification**

**Specification:
EE&QA-886**

OCS Inspection Car Consist Procurement

Appendix A: Materials and Workmanship Requirements

Page: -

Date: December 19, 2017

Revised: November 25, 2020

Revision: 2.0

Appendix A

Materials and Workmanship Requirements



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Revised: November 25, 2020

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1 MATERIALS AND WORKMANSHIP REQUIREMENTS

1.1 General

- 1.1.1 This Section defines the minimum performance requirements for materials to be used in construction and establishes minimum guidelines for workmanship.
- 1.1.2 The Contractor may propose, for MBTA review and approval, alternate materials, specifications, and standards they customarily use that have a proven service history in a rail transit application.
- 1.1.3 Upon completion of manufacture and before any operation shall begin, all parts shall be clean and free from scale, rust, water, and/or any contamination.
- 1.1.4 All materials and workmanship must meet the quality standards of this contract and the intended use.
- 1.1.5 Inclusion of a material or product in this section does not imply Approval of its use in a particular application. Refer to other Sections within the Technical Specification for detailed requirements for specific vehicle systems.
- 1.1.6 Materials used in construction shall be indicated on all drawings.
- 1.1.7 Safety Data Sheets (SDS) compliant with ANSI Z400.1/129.1.2010 shall be submitted for all materials used in the cars along with a list of the application of each material. This requirement excludes non-hazardous metallic materials.
 - 1.1.7.1 Use of any materials listed in 29 CFR 1926 Subpart Z must be explicitly approved by MBTA.
- 1.1.8 A list of recommended cleaning agents and lubricants and their applications on the vehicle with their associated technical or application data sheets and MSDS shall be provided to the MBTA.

1.2 Prohibited Materials

- 1.2.1 PVC; asbestos; cadmium (except for battery); lead, except for solder; PCBs; confirmed or suspected carcinogenic materials as listed by current Publication of the American Conference of Governmental Industrial Hygienists (ACGIH); plywood chemically treated for fire and smoke retardancy; materials listed in 29 CFR 1910.19; and urethane foam shall be prohibited from use on the cars or in products used on the cars.

1.3 Metal

1.3.1 Steel

- 1.3.1.1 Shall meet the requirements of ASTM A500, A570, A588, A606 or approved equal.



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- 1.3.1.2 All steel plates, shapes, bars, and sheets shall be of a quality that has good weldability and high impact resistance.
- 1.3.1.3 Steel items shall be of alloys and grades normally used for maintenance of way equipment and railway rolling stock.
- 1.3.1.4 Welded high-strength low-alloy (HSLA) steel shall develop 15ft-lbs (20 Joules) Charpy V Notch impact strength in the CGHAZ (coarse grain heat affected zone) 1 mm from fusion area at -20°F (-29°C).

1.3.2 Non-Ferrous

- 1.3.2.1 All non-ferrous metals shall be of alloys having strength and corrosion resistance suitable for the service and operating environment intended.

1.3.3 Other

- 1.3.3.1 Other supplier standard metallic materials may be proposed, subject to MBTA review and approval.
- 1.3.3.2 If use of forgings or castings is proposed, the supplier shall provide their associated quality control procedures for MBTA review and approval.

1.4 Joining and Fastening

1.4.1 General

- 1.4.1.1 All joints shall be properly aligned, tight and durably constructed, whether exposed or concealed.
- 1.4.1.2 The Contractor shall minimize the possibility of corrosion or electrolysis by isolating dissimilar metals.

1.4.2 Fasteners

- 1.4.2.1 All fasteners shall also conform to the Fastener requirements of Section 3.8.6 and 3.8.7 of the Technical Specification.
- 1.4.2.2 All fasteners shall meet requirements of ASTM-A-325 Grade BD, A-490, SAE J429 Grade 5 or 8 or ISO/DIN Grade 8.8 or 12.9 as applicable.
 - 1.4.2.2.1 Nuts shall meet the requirements of ASTM A-194, A-325, or A-563, SAE J995 Grade 5 or 8 or ISO/DIN 980 as applicable.
 - 1.4.2.2.2 Nuts and Bolts with U.S. threads shall be a Class 2 fit, minimum.
- 1.4.2.3 The Contractor shall use certified fasteners.



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- 1.4.2.3.1 The Contractor shall be aware of the high possibility of counterfeit fasteners available.
- 1.4.2.4 All fasteners shall be plated or anodized to avoid corrosion or galvanic reaction to the mating surfaces
- 1.4.2.5 All bolt applications shall have at least two (2) full threads protruding beyond the nut and no more than six (6) threads protruding beyond the nut after the fastener has been torqued.
- 1.4.2.5.1 All fasteners shall be properly torqued and torque stripe applied.
- 1.4.2.6 All fastener certifications shall be maintained by the Contractor for inspection by MBTA until all warranty/reliability periods have expired.
- 1.4.2.7 Threaded fastenings and other machine elements, not specified elsewhere, shall conform to ASTM, SAE, ANSI, and ISO requirements, as applicable.

1.5 Welding

1.5.1 AWS or MBTA Approved Alternate

- 1.5.1.1 All welding, unless otherwise specified, shall be in accordance with the requirements of the applicable American Welding Society (AWS) Specifications, including AWS D1.1, AWS 15.1, AWS D1.2, AWS D1.3 and AWS C1.1.
 - 1.5.1.1.1 The Contractor may propose the use of alternate welding standards, such as EN, for MBTA review and approval.
- 1.5.1.2 The Contractor shall ensure that welders are qualified to operate welding equipment and produce the specified welds by having met the conditions of the applicable welding code.
- 1.5.1.3 All welds must comply with the associated and established American Welding Society (AWS) standards

1.5.2 Drawings and Procedures

- 1.5.2.1 Welds shall conform to the fabrication drawings and be free from defects such as incomplete penetration, lack of fusion, excess metal, undercut, porosity, overlap and cracks.
- 1.5.2.2 Upon request, the Contractor's welding procedures, Welder qualification records, procedure qualification records, and associated drawings shall be submitted to MBTA for review and approval.



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1.5.3 Materials and Welding Practice

1.5.3.1 Aluminum

- 1.5.3.1.1 Aluminum-Welding rod, wire or filler material shall be chosen with respect to make, type, size, composition and in accordance with Chapter 94 of the AWS Handbook.
- 1.5.3.1.2 The welding of aluminum shall conform to the provisions and recommendations of the AWS publication, Welding Aluminum.

1.5.3.2 Carbon Steel

- 1.5.3.2.1 Welding electrodes for steel and manual shielded metal-arc welding shall conform to E60 or E70 series.

1.5.3.3 Stainless Steel

- 1.5.3.3.1 The materials for welding stainless steel shall conform to the provisions and recommendations of Section IX of the ASME Boiler and Pressure Vessel Code or other approved code.
- 1.5.3.3.2 All parts to be joined by welding shall be adequately supported during the welding operation to ensure minimal distortion.
- 1.5.3.3.3 All welding shall produce complete and adequate fusion with the basic material throughout the weld.

1.5.3.4 Resistance Welds

- 1.5.3.4.1 Resistance welding operations shall employ accurate control of cleanliness, current, time, electrode size and shape, and tip force to produce uniform welds of specified strength, which shall not be subject to surface corrosion.
- 1.5.3.4.2 For each type of metal joint or built-up assembly to be resistance welded, a prior sample of the joint shall first be welded with the prescribed settings of current, time and tip pressure, and then either static tested for shear strength or tested to destruction by tearing to ensure that a weld nugget is pulled out of one of the plates.

1.5.3.5 Defect Repair Welding or Special Cases

- 1.5.3.5.1 Welding to repair defects shall be accomplished in accordance with a Contractor supplied and MBTA approved procedure.

1.5.4 Non-Destructive Inspection

- 1.5.4.1 Non-destructive inspection, when requested or required, shall be accomplished in accordance with the following:



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1.5.4.1.1 Magnetic Particle Inspection

- 1.5.4.1.1.1 Magnetic particle inspection shall be performed in accordance with either ASTM E 109 or ASTM E 138.
- 1.5.4.1.1.2 After magnetic particle inspection, parts shall be sufficiently demagnetized so that the residual field will not interfere with future processing or operation of the part.

1.5.4.1.2 Penetrant Inspection

- 1.5.4.1.2.1 Penetrant inspection, both fluorescent and dye penetrant shall be performed in accordance with ASTM E-165.

1.5.4.1.3 Radiographic Inspection

- 1.5.4.1.3.1 Radiographic inspection, when required, shall be performed in accordance with ASTM E 142.
- 1.5.4.1.3.2 Sensitivity shall be 2% (2-2T hole visible in the appropriate penetrometer).
- 1.5.4.1.3.3 Film density shall be between 3.0 and 5.0 for areas being inspected.

1.6 Electrical System

1.6.1 General

- 1.6.1.1 Electrical Systems shall conform to the regulations of the American National Standards Institution (ANSI) and the International Standards Organization (ISO) where applicable.
- 1.6.1.2 Sequence of operation and electrical, physical, and schematic drawings showing the exact circuit(s) in use on the machine and large enough to be easily followed during trouble-shooting shall be furnished.
 - 1.6.1.2.1 Subsequent changes shall be covered by new drawings furnished to the customer.
- 1.6.1.3 All relays, circuit breakers, switches, circuit boards, equipment racks and similar components shall be industrial, heavy-duty type and have a proven service history in a rail transit application, to the extent possible.
- 1.6.1.4 Whenever practical, components shall be interchangeable.

1.6.2 Cable and Wiring

- 1.6.2.1 All cables and wiring shall be protected and enclosed in conduit, tubing, and wire trays and routed to prevent exposure to damage.
 - 1.6.2.1.1 Adhesive type materials shall not be used to protect or route cable or wiring.



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1.6.2.1.2 Conductors with voltage differences exceeding 50 volts shall be in separate routings.

1.6.2.2 Wires shall be equipped with good quality ring lug or push-on type terminals and identified with permanent numbered markers, color coded when practical.

1.6.2.2.1 Terminal posts shall be plainly marked.

1.6.2.2.2 Once used, a number or color code shall not be reused for a different circuit.

1.6.2.2.3 All wires shall be neatly dressed and clamped.

1.6.2.2.4 Selection of wire sizes and insulation ratings shall be based on current carrying capacity, voltage drop, mechanical strength, temperature and flexibility requirements in accordance with AAR, ICEA, and NEC specifications.

1.6.2.2.5 Wire and cabling shall meet the requirements of APTA-PR-E-RP-009-98 or the following:

1.6.2.2.5.1 General Wiring – Machine Tool Wire (MTW), meeting UL758, UL1063, and UL1426.

1.6.2.2.5.2 Power Cabling – DLO XLPO, meeting AAR (S-501 & RP-585) and ICEA, materials compliant to UL VW-1, NFPA-130, ASTM E662 or DLO EPDM, meeting UL RHH-RHW-2 and MSHA Approved, materials compliant to UL VW-1.

1.6.2.2.5.3 Alternative materials proposed are subject to MBTA review and approval.

1.7 Hose and Tube

1.7.1 Air Brake System

1.7.1.1 Air brake pipe and hose shall comply with the requirement of Technical Specification Section 8.3.

1.7.2 Hydraulic System

1.7.2.1 Hydraulic hose shall meet the requirement of SAE 100R with pressure rating above the maximum system pressure including transient spikes.

1.7.2.2 Hydraulic hose shall be mounted to be within the hose manufacturers' guidelines and recommendations.

1.7.2.3 Hydraulic tube shall be stainless steel and utilize O-ring type connections.



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1.8 Paint

1.8.1 General

- 1.8.1.1 The Contractor shall use paints which meet OSHA regulations and standards, and do not have any known history of biological hazards due to long term exposure.
- 1.8.1.1.1 Passive respirators and eye protection shall be the only safety or health equipment necessary to protect MBTA workers making future repairs.
- 1.8.1.2 The Contractor shall utilize proper surface preparation, including the removal of weld scale, flux, and spatter.
- 1.8.1.3 Rust inhibiting primer compatible to the surface finish shall be used.
- 1.8.1.4 The surface coat shall be epoxy, urethane, or other type compatible with the primer coat, and have a glossy, high quality, durable finish which resists dulling, fading, or chalking when maintained with suitable cleaning compounds.
- 1.8.1.5 All equipment shall be protected by finishes suitable to the environment.
- 1.8.1.6 Exterior metal exposed to the elements shall be finished by a minimum three (3) coat process.
- 1.8.1.6.1 The primer coat shall contain a rust inhibitor phosphatized coating and be thoroughly bonded to base metals.
- 1.8.1.7 Exposed parts of the OCS Car Consist shall be painted U-Tech Chrome Yellow # UTCB9355- MX/GL, Urethane (or MBTA approved equivalent) except as follows:

Diesel Fuel Tank:	GREEN
Hydraulic Reservoir:	BLUE
Coolant Tank:	GRAY
Lifting Lugs:	BLACK
Safety Locks:	RED
Jacking Points or Pads:	BLACK
Engine and Other Parts:	Contractor's Option

1.8.2 Marking

- 1.8.2.1 Placards shall be a minimum 1/8 inch thick, UV stable, impact resistant acrylic.
- 1.8.2.1.1 Surface color shall be black. Core color shall be white.



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- 1.8.2.1.2 Engraving depth shall be sufficient to expose the core color.
- 1.8.2.1.3 Placards shall be mounted with hardware. Adhesives are not approved.
- 1.8.2.1.4 The name of fluid and the words "CHECK DAILY" shall be stenciled on each tank in 1" letters.
- 1.8.2.1.5 Total vehicle weight with all tanks filled shall be plainly marked on both sides of the vehicle in 1-1/2" letters: WEIGHT _____ Lbs. (Contractor to fill in the blank).
- 1.8.2.1.6 Each vehicle shall be numbered per MBTA standard 4 or 5 character designation in eight inch black stenciled letters and numbers as high as possible on the sides and ends of vehicles.
- 1.8.2.1.7 The vehicle number shall also be stenciled inside the cab in plain view of the operator.
- 1.8.2.1.8 Stand Clear, Danger, High Temp, Pinch Point and all other applicable safety warning labels/stencils shall be utilized where needed.

1.9 Flammability, Smoke Emission and Toxicity

- 1.9.1 Combustible materials used in the construction of the cars shall satisfy the flammability, toxicity and smoke emissions requirements of this section and NFPA 130.
- 1.9.2 Materials and products generally recognized to have highly toxic products of combustion shall not be used.
- 1.9.3 All materials used in the car construction, except for materials used in small parts such as knobs, rollers, fasteners, clips, grommets, and small electrical parts that would not contribute significantly to fire propagation or to smoke or toxic gas generation, shall be tested for toxicity using Boeing Specification Support Standard BSS-7239.
- 1.9.4 Materials shall meet the following maximum toxic gas release limits (ppm) as determined per BSS-7239:

PRODUCT	MAXIMUM RELEASE LIMIT
Carbon Monoxide (CO)	3,500 ppm
Hydrogen Fluoride (HF)	200 ppm
Nitrogen Dioxide (NO ₂)	100 ppm
Hydrogen Chloride (HCl)	500 ppm
Hydrogen Cyanide (HCN)	150 ppm
Sulfur Dioxide (SO ₂)	100 ppm

- 1.9.5 The tests shall be conducted in the flaming mode after 240 seconds, using the NBS Smoke Density Chamber for sample combustion.



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- 1.9.6 The gas sampling may be conducted during the smoke density test.
- 1.9.7 The test report shall indicate the maximum concentration (ppm) for each of the above gases at the specified sampling time.
- 1.9.8 In lieu of the requirements in Appendix A Sections 1.9.1 through 1.9.7, the Contractor may demonstrate mitigation of flame, smoke, and smoke toxicity hazards through the hazard analyses required in Section 15.3.4.3 of the Technical Specification, subject to MBTA approval.

1.10 Material Delivery

- 1.10.1 Equipment shall be constructed, prepared, and loaded so that it will withstand without damage handling likely to be encountered during delivery.
- 1.10.2 Valuable and easily pilfered parts such as batteries, tools, and loose small items shall be shipped in such a manner as to resist pilferage.